The Dual Labor Market: Trends in Productivity, Wages and Human Capital in the Economy

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Abstract

The Israeli economy is characterized by a severe duality. At one end are the advanced high-tech industries, with high and quickly rising labor productivity. At the other end are industries characterized by low-productivity and minimal growth. This chapter examines the characteristics of this polarization in the labor market, which began in the second half of the previous century. The chapter examines why the success of the high-tech sector has not led to improvements and streamlining in the rest of the economy, and shows that, over the years, the two sectors have further diverged in terms of worker traits, college wage premiums and labor productivity. At the same time as employment mobility between sectors declined, the relationship between the wages in the high-productivity and low-productivity sectors also diminished. The chapter raises the possibility that by diversifying the Israeli export market, it may be possible to apply pressure on wages in industries with low-productivity and to encourage them to streamline their processes, ultimately leading to a narrowing of gaps within the Israeli labor market. The authors also recommend encouraging research and development in low-technology industries and creating avenues for vocational training that will enable better employment mobility between the various sectors.

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Introduction

Productivity – the ratio of total GDP to total work hours – measures the total value of goods and services produced in an average work hour, expressing the economy's productive capacity considering all available inputs. Since a substantial rise in wages relies on an increase in productivity, an improved standard of living must be supported by growth in productivity.[1]

This chapter presents a long-term comparison concentrating on the business sector and indicates that productivity has developed unevenly in different economic sectors. Productivity has risen rapidly in tradable industries (those that are engaged in the international market place) while in non-tradable industries (those that are primarily engaged in the local market), productivity has remained almost unchanged.

Existing economic literature has found that tradable industries have a greater growth potential, and that the ratio of productivity in tradable industries to that in non-tradable industries rises together with a country's income level. However, the present chapter shows that the stagnation in productivity in the non-tradable industries is quite unique even in comparison to other OECD countries. The Bank of Israel (2014) found that compared to other OECD countries, productivity in non-tradable industries was low, while the productivity in exporting industries was similar to that in other developed countries. It was also found that the negative correlation between an industry's export rate and the productivity gap relative to other countries is seemingly unique to Israel.

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[1] The extent to which an increase in productivity results in a rise in wages is dependent, among other things, on the bargaining strength of workers facing their employers. An increase in labor productivity is a necessary, but not sufficient, requirement for a rise in wages. In theory, it is possible that productivity growth can lead to a rise in return on capital without a rise in wages. Evidence of this is presented by the Bank of Israel (2011) and Kimhi and Shraberman (2014). On the other hand, the Bank of Israel (2015) finds evidence for a mean reversion in the labor income share over long periods.

According to standard economic theory, any positive shock in productivity in a given sector, say tradable industries, raises the demand for workers in that sector, thereby increasing both wages and employment in that sector. Theoretically, if the workers in the non-tradable sector are perfect substitutes (fully identical) to workers in the tradable sector, and there is perfect mobility between the sectors, then employment in non-tradable industries would decrease, and wages would increase to the same degree as in the tradable sector. This increase results from decreasing marginal returns and from workers moving to sectors where wages are higher. Nonetheless, Lavi and Friedman (2007) show that increased productivity and wages in the tradable industries did not bring about wage pressures in the non-tradable industries in Israel. They raise the possibility of polarization in the labor market, with workers' traits, such as education and human capital, differing greatly between the tradable and non-tradable sectors and, as a result, wages in each sector develop differently and independently.

The present chapter examines Lavi and Friedman's hypothesis as one of the factors causing the differences in productivity development. The first section examines the relevant literature and presents the basic data. The second section presents the growth of productivity and wages, while dividing the economy into four sectors: an initial division into tradable and non-tradable industries, and a further division of each industry by productivity level (high or low). The third section sheds light on the development of the relationship between wages in different sectors. The fourth section focuses on the causes of the differences in productivity between the various sectors and shows that the deep differences in workers' traits in each sector and the decrease in mobility from one industry to another partly explain the polarized trends in productivity and wages between the sectors. The fifth section presents an empirical test of the productivity gaps, controlling for the differences in workers' traits, while addressing nominal and real differences in labor productivity development. The sixth section presents conclusions and recommendations, primarily increasing research and development in low-

technology industries and the creation of vocational training programs to increase occupational mobility between industries.

1. Labor Productivity in Israel

An extensive body of literature has been written in recent years on labor productivity in Israel. Publications have followed two approaches, each with a different focus. One approach examines the economy as a whole, while the other differentiates between various sectors of the labor market. This chapter takes the latter approach.

Generally, the studies find a growing gap between productivity abroad and productivity in the Israeli economy. They ascribe the gap to different characteristics of the Israeli economy, including: low competition in the local business environment; extensive bureaucracy; long work hours; a relatively young population with little labor market experience; a relatively low-quality education system;[2] low ratio of capital to GDP;[3] and a sizable defense sector (Bank of Israel, 2013; Sarel, 2013).[4]

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[2] Hanushek and Woessmann (2012) show that the quality of the early years of education is more related to economic growth than it is to human capital as measured in the number of years of schooling. According to this approach, it is possible that failures in the early stages of educational acquisition cannot be fixed by a college education, and, thus, the relatively high rates of higher education in Israel are not fully expressed in productivity terms.

[3] Sarel (2013) shows that about 24 percent of the difference between labor productivity in Israel and the OECD average is linked to a lower level of worker capital, and the rest of the difference is the result of general differences in productivity.

[4] It is possible that part of the gap in productivity is explained by Israel's geographic location. Boulhol, Serres and Molnar (2008) find that distance from the economic center explains part of the gap in per capita GDP between OECD countries. For example, in Australia and New Zealand, the distance reduces per capita GDP by 10 percent, and contributes about 6-7 percent to per capita GDP in Belgium and the Netherlands.

As already noted, when studies examine productivity by industry, it is found that productivity in Israel is low in international comparisons primarily in non-tradable industries. In the tradable industries, in contrast, productivity in Israel is higher than, or similar to, that of other developed countries (Bank of Israel, 2014; Regev and Brand, 2015).[5]

Figure 1 shows the growth of overall productivity starting in the mid-1970s in the commerce and services industries, which comprise a significant part of the non-tradable sector, compared with manufacturing sectors, representing the tradable sector. Until the 1990s, there was an almost perfect correlation between the two sectors, whereas after that period, as the economy was exposed to competitive imports, the overall growth in industrial productivity began to accelerate in the tradable industries, along with a certain decrease in productivity in the non-tradable industries.[6,7] As noted, the economic literature indicates that

[5] Rodrick (2011) finds that GDP per worker in the manufacturing sector tends to converge between countries as opposed to GDP per worker over all industries.

[6] It is possible that the wave of immigration from the former Soviet Union in those years affected the overall productivity in the economic sectors in an uneven way. For example, Zussman and Friedman (2008) show that the immigration lowered the quality of the labor force in those years since the new immigrant human capital was not particularly suited to the labor market needs in Israel, and the process of integration into the market was accompanied, at least at the beginning, by workers being employed in work other than in their professions. Brezis and Krugman (1996) show that appropriate integration of immigrants from the former Soviet Union into the labor market can improve the quality of the labor force and lead to higher level wages in the market place in the long term, despite downward wage pressures at the beginning of the integration process.

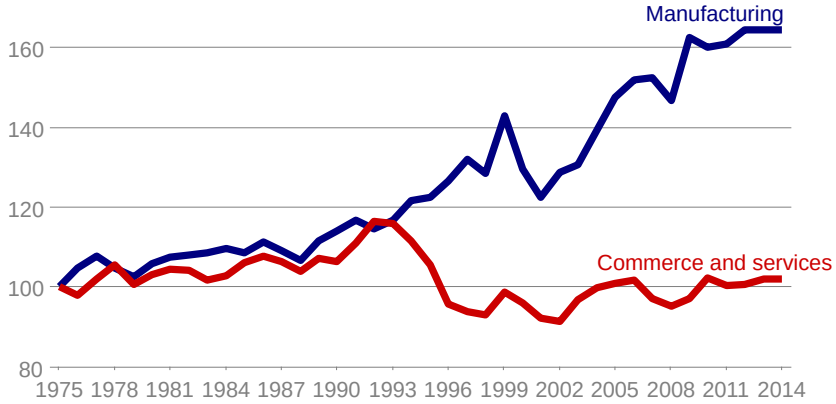
[7] It is possible that the opposing trends in overall productivity in the various industries beginning in the 1990s stems from, among other things, the diversion of labor from the industrial to the service sector. De Michelis, Estevao and Wilson (2013) find a negative relationship between labor force growth and overall growth in productivity. According to their study, a rise in

labor productivity in the non-tradable industries is less affected by innovation and technological advances than in tradable industries, so their growth potential is more limited. However, the slight decline in productivity in these sectors requires further explanation.

Figure 1

Productivity in the manufacturing industry and the commerce and services industry

Index: 1975=100, 1975-2014



Source: Gilad Brand and Eitan Regev, Taub Center
Data: Bank of Israel

Many studies have indicated a positive correlation between exports and labor productivity, but the causality can go in either direction. On the one hand, high-productivity is expected to affect a company's decision to compete on international markets. On the other hand, the experience accumulated through exposure to new markets and technological developments worldwide, as well as the intensive competition on the

labor inputs diminishes the incentive for employers to streamline their work methods. A similar finding can be seen in the study by Junankar (2013).

international market, increases the company's innovation and the workers' productivity.[8]

Helpman, Itskhoki and Redding (2010) and Helpman, Itskhoki, Muendler, and Redding (2012) find that in equilibrium, trade liberalization shifts higher ability workers to exporting firms, which have higher productivity and pay higher wages. Such movement can indeed explain to some degree the difference in productivity development between the different sectors presented in Figure 1 above. Amiti and Davis (2012) find that tariff cuts reduce wages at companies that are oriented exclusively to the domestic market while raising wages at those that export a sufficient share of their output.

To compare the wages and labor productivity in the various sectors of the Israeli economy, the business sector will be divided into four relatively homogeneous groups, representing different levels of technological intensity and business environment:[9]

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[8] Gallo (2011) estimates the relationship between export and productivity in local companies in the years following trade liberalization in the Israeli market in the 1990s. The findings show that the productivity of exporting companies is higher than non-exporting companies, and that after a company begins to export, its productivity rises by 12 percent in five years.

[9] Dividing the industries by productivity was determined by the average labor productivity in 2010 in industries in the sample. Industries that were below the average were classified as low-productivity industries; industries over the average were classified as high-productivity. The division in tradability sectors was determined using two criteria: the export rate and competing import rate in the industry. Industries that export more than 15 percent of their supply or in which the rate of competitive imports is more than 25 percent of their output were classified as tradable industries (according to the Input-Output Tables of the Central Bureau of Statistics, 2006). Further support for the criterion is found through a series of Chow tests. This division is similar to tradable industry classifications in the literature. For example, Zussman (1998) classifies tradable industries where the export rate is over 10 percent of the output.

Non-tradable low-productivity industries. Service and commerce industries (except computer services and research and development) and non-tradable low-technology industries (food, paper and print).

Tradable low-productivity industries. Low and medium-low industries and tradable manufacturing industries.

Non-tradable high-productivity industries. Banking and other financial institutions, telecommunications, beverages and tobacco.

Tradable high-productivity industries. Computer services and research and development, medium-high and high technology manufacturing industries, water and air transport, and auxiliary transport activities.[10]

This division is presented in detail in Appendix Table 3. This chapter focuses on the business sector alone,[11] excluding a few industries: agriculture and construction (characterized by a high rate of foreign labor employment); mining and quarrying; diamonds;[12] real estate activities; and rentals of machinery and equipment. As a result of these omissions, this analysis includes about 60 to 65 percent of all employees and 90 to 95 percent of all employees in the business sector in Israel.

Figures 2A and 2B show the labor force breakdown in these four groups in 1995 and 2010. The main development during this period was the steep decline in working hours in low-technology industries. Likewise, it can be seen that the vast majority of workers in the business sector are employed in non-tradable commerce, services and

[10] Transportation industry includes shipping agencies, air transport agencies, custom clearing agencies, and travel and tourist agencies.

[11] The business sector does not include the following industries: foreign agencies and organizations; community and social organizations; health, welfare and nursing care; electricity and water; local authorities; community centers; waste management and services; religious services; educational services.

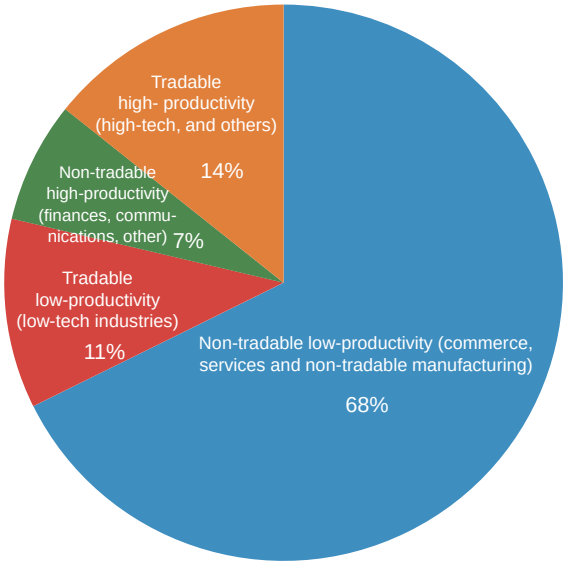
[12] In international classifications, the diamond industry is combined with other industries; for this reason it is included in international comparisons (Figures 3 and 4).

manufacturing. As such, some of the discussion in this chapter will be a comparison between this group (hereinafter: non-tradable low-productivity sector) and the three other groups combined into a single group (hereinafter: the combined sector).

Figure 2A

Distribution of work hours by industry sector, 1995

by sector

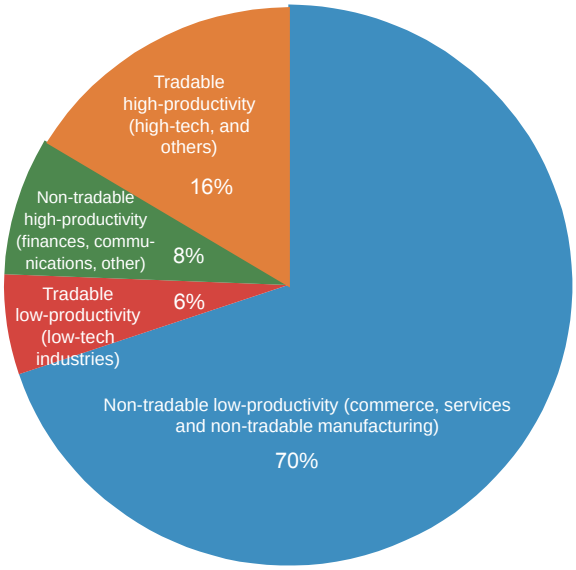


Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

Figure 2B

Distribution of work hours in the business sector, 2010

by sector



Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

2. *Trends in Productivity and Wages by Business Sectors*

Figure 3 shows the annual growth rate in productivity per work hour and productivity per worker in the four groups defined above. From 1995 to 2010 there was growth in productivity across three of the four groups. Only in the non-tradable low-productivity sector was there a decline in

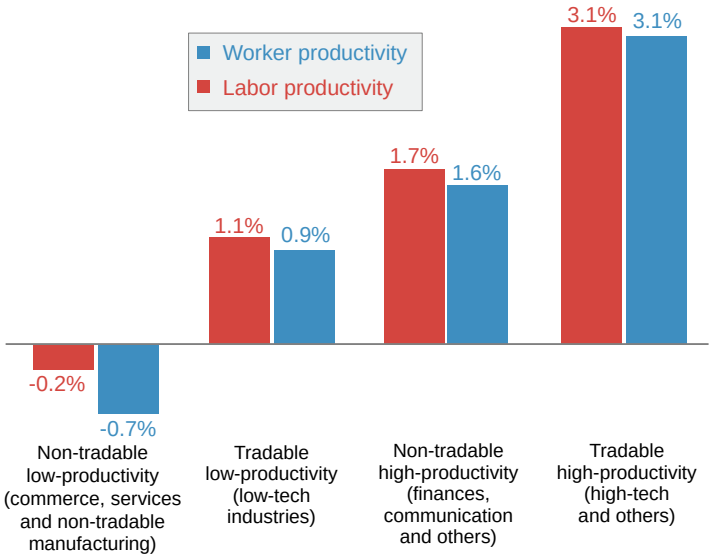
productivity per work hour and in productivity per worker at an average rate of 0.2 percent and 0.7 percent per year respectively.[13]

[13] Measuring the real productivity growth in different economic industries ideally requires using appropriate price indices for each industry. In the service and commercial industries, though, inflation is more difficult to measure on an industry level, and fitting a price index to each industry is less accurate. Therefore, it is possible that the negative growth in the non-tradable industries is the result of, among other things, measurement bias. To test the extent of possible bias, prices were also deflated by the GDP business sector deflator. Since the prices in non-tradable sectors tend to rise faster than in tradable sectors, the development of productivity in the non-tradable sectors is most likely below this level. In other words, the price index for business sector product allows an evaluation of the upper boundary of non-tradable industry productivity development. The results using the index indicate an annual growth rate of 0.8 and 0.4 percent in labor productivity and productivity per worker, respectively. The conclusion is that the productivity in non-tradable industries rose at a lower rate and by the end of the previous decade was close to the level of the second half of the 1990s.

Figure 3

Rate of annual growth in worker productivity and labor productivity, 1995-2010

in the 4 industry groups in the business sector
(using the Israeli classification)



Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

Figure 4 presents a comparison of labor productivity in the examined sectors compared to a sample of the 12 OECD countries for which data exist for the period under study.[14] The figure makes it clear that in other

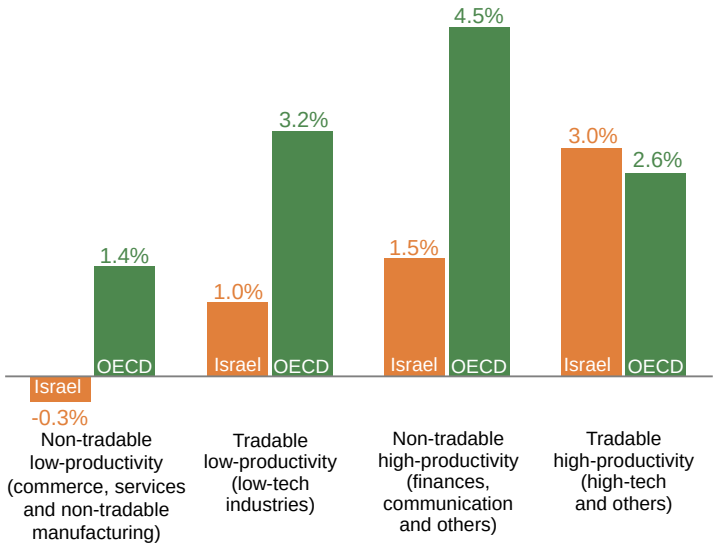
[14] The sample includes Austria, Canada, Czech Republic, Denmark, Finland, Greece, Hungary, Netherlands, Norway, Slovakia, Spain, and Sweden. Average labor productivity in these 12 countries is similar to the average of all the countries in the OECD. Thus, this sample represents a relatively good proxy (see Regev and Brand, 2015).

developed countries as well the non-tradable industries tend to exhibit slow growth compared to other industries, but the negative growth rate seen in Israel is exceptional.[15]

Figure 4

Rate of annual growth in labor productivity, 1995-2009

Israel and 12 OECD countries (using the international classification), in the 4 industry groups in the business sector



Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics; OECD

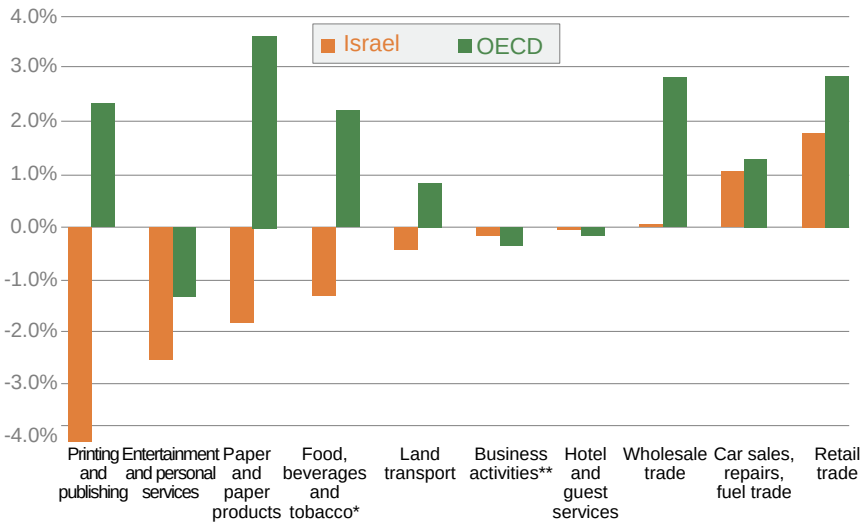
[15] There are differences between the classification of sectors by the Central Bureau of Statistics and the international classification systems. As such, there are certain differences in international groups presented here and the rest of the comparisons. Appendix Table 1 in Regev and Brand (2015) presents the groupings in Israel and the corresponding international classification.

Figure 5 examines in further detail the labor productivity in the industries comprising the non-tradable low-productivity sector in Israel and in the comparison countries. Most of the industries included in this sector in Israel are characterized by negative productivity growth; the growth rate in the sample OECD countries is faster in the majority of industries in the category.

Figure 5

Rate of annual growth in labor productivity in commerce, services and non-tradable manufacturing, 1995-2009

Israel and 12 OECD countries (using the international classification)



* In Israel, beverages and alcoholic beverages are included in the food industry. In the OECD, they are in the tobacco industry. For comparison purposes, the two industries were combined for both Israel and the OECD classification.

** The OECD includes in this industry worker recruitment and employment services and guarding, security and cleaning services that are separate in the Israeli classification.

Source: Gilad Brand and Eitan Regev, Taub Center

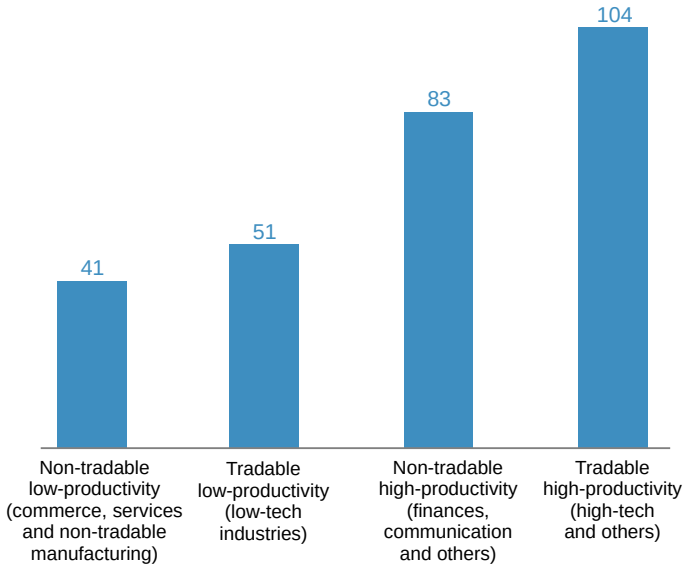
Data: Central Bureau of Statistics; OECD

To complete the picture, wages in each of the sectors were examined for 2010 (Figure 6A) as well as wage growth from 1995 to 2010 (Figure 6B). As can be seen in Figure 6A, the cost of an hour of labor in the non-tradable low-productivity sector was NIS 41 in 2010, substantially lower than in the other sectors, while wages in the high-tech industries were highest, at NIS 107 per hour.[16] Figure 6B shows that wages in the tradable industries grew relatively quickly: 1.4 to 1.8 percent per annum (in real terms). However, in the non-tradable industries wages grew at a relatively slow rate.

Figure 6A

Wage costs per hour per worker, 2010

in the 4 industry groups in the business sector, in shekels



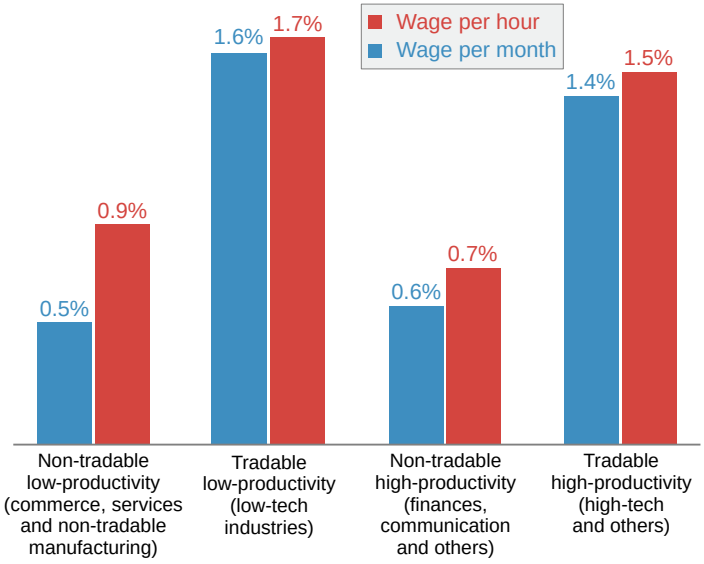
Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

[16] Wage costs to the employer include payments such as social benefits and employer payments to the National Insurance Institute.

Figure 6B

Rate of annual growth in per hour and per month wage costs per worker, 1995-2010

in real terms, in the 4 industry groups in the business sector



Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

3. *Wage Development*

The previous section presents the differences between sectors in productivity and wages, and the growth rates in each. In this section, the development of the correlation between wage trajectories in the various sectors will be examined.

As explained in the introduction, it may be expected that increased productivity in one sector will attract workers to that sector and cause wages to increase in all the other sectors as well. However, Lavi and Friedman (2007) show that increased productivity in the exporting industries does not affect wages in the non-tradable sector, and assume that the relationship between wages in the two sectors is weak.

Table 1 examines the relationship between wage development in the different sectors, and presents the Pearson Product-Moment Correlation coefficients for wage costs per hour in the different groups.[17] Each cell shows the correlation coefficient between two sectors over 16 years (1995-2010). The groups are ranked from left to right and from top to bottom by average wages within the group (low to high). The comparison's notable findings are the close correlation between wages in different sectors, and in particular between tradable and non-tradable low-productivity industries (a correlation of over 96 percent).

Table 1. **The correlation between salary and the 4 industry groups in the business sector**

Pearson Product-Moment Correlation

	Tradable low-productivity	**Non-tradable high-productivity**	**Tradable high-productivity**
Non-tradable low-productivity	96.3%	76.7%	91.6%
Tradable low-productivity	--	70.5%	91.1%
Non-tradable high-productivity	--	--	86.9%

Source: Gilad Brand and Eitan Regev, Taub Center

[17] Pearson Product-Moment Correlation is an index of correlation between two groups of numbers which gives a value ranging from 1 (for a full correlation) to 0 (for no correlation). Results are similar even when the comparison is carried out for monthly wages.

To shed light on the development of the correlation over the years, the coefficients between wages in the different groups were calculated over only 12 years (rather than the 16 in Table 1), for five consecutive periods (start year: 1995 until 1999). The comparison is presented in Figure 7, and it indicates that the correlation between wages in the different sectors weakened over the years in all industries, but not to the same degree. The correlation between low-productivity industries and high-productivity industries weakened substantially, while the correlation between tradable and non-tradable high-productivity sectors remained relatively strong.[18] This result may be due to higher worker mobility between sectors at similar productivity levels.

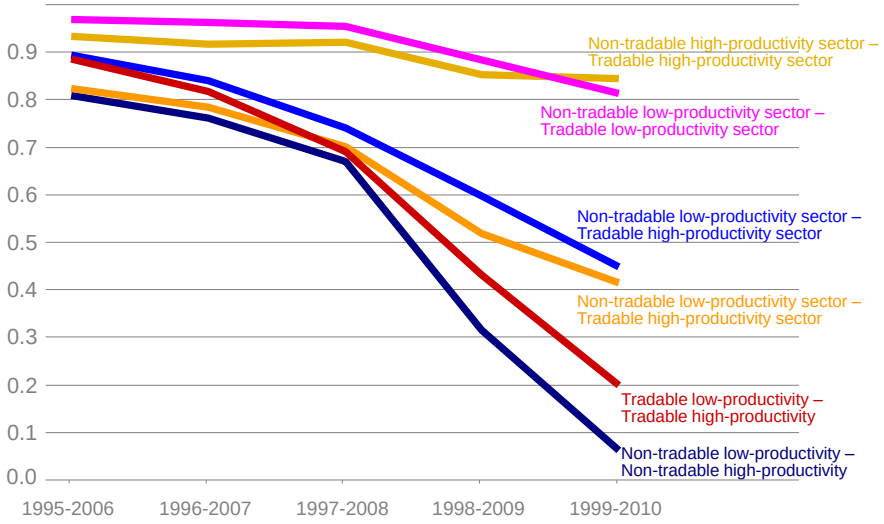
Another comparison, presented in Appendix Section 1, indicates that the combined sector is more dominant in determining wages, meaning companies in the non-tradable low-productivity sector react with a delay to the wage development in combined sector companies (and not vice versa), at least for skilled workers. This may support the assertion that productivity growth in some industries leads to wage pressures in other industries, as in the case of skilled workers, but perhaps to a lesser extent than in the past.

[18] Sensitivity tests show this result is consistent and does not change with the selection of different years.

Figure 7

The Pearson Product-Moment Correlation coefficient for salaries* in the 4 industry groups in the business sector

by periods, 1995-2010



* Wage costs per work hour. Similar results are obtained for wage costs per month.

Source: Gilad Brand and Eitan Regev, Taub Center

Data: Central Bureau of Statistics, *Labor Force Surveys*

4. The Causes of Gaps in the Growth Development of Productivity and Wages

It is reasonable to assume that differences in productivity growth and the weakening of the relationship between workers' wages in the different sectors are rooted in, among other things, the deep differences between worker traits. This section examines the differences between worker traits by following developments in human capital in each sector. Further on,

the uneven development of prices in the various industries and their effect on the productivity gaps will be examined.

Differences in Worker Profiles

Figure 8 shows the share of college graduates in the non-tradable low-productivity sector and the combined sector.[19] It is apparent that human capital has improved overall in the market industries, but the accumulation of human capital in the combined sector rose more quickly than in the non-tradable low-productivity sector.[20]

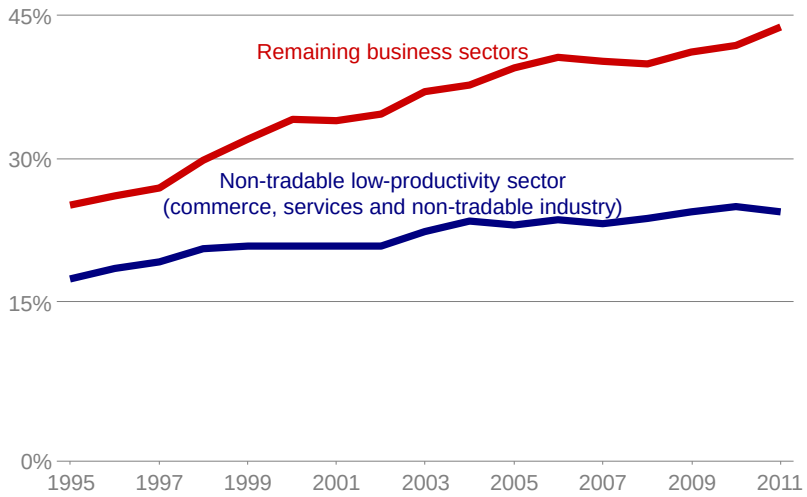
[19] Identification of academics was done by number of years of schooling (at least 15) and last place of schooling (academic) and not according to certificate or last degree, since data on the year of the degree are not available in the Central Bureau of Statistics *Income Survey* for the entire study period.

[20] Friedman (2013) shows that the rise in productivity and labor wages in information and communication technologies in the second half of the 1990s brought about a sharp increase in the quality of the labor force in the other industries. This rise strengthened the uniqueness of the human capital of workers in industries biased towards export.

Figure 8

Share of college educated workers, 1995-2010

by sector



Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

Figure 9A shows the distribution of workers with no more than an upper secondary school education across the sectors in 1995 and 2011, and Figure 9B shows that of workers with a college education during those years. In addition to the usual division into four sectors by tradability and productivity, the non-tradable low-productivity sector was further divided along the median wage in that group (in 2010). The five groups are ranked descending from left to right by the average wage in each group.

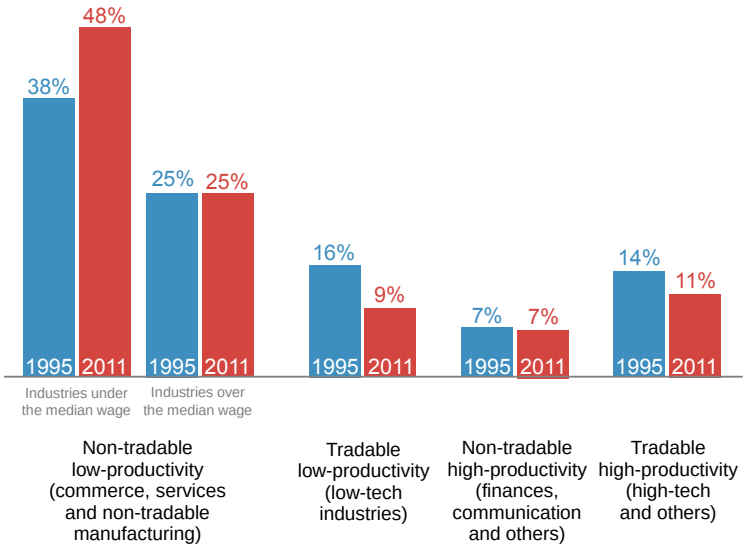
The distribution of workers indicates the portion of workers with no more than a high school education in each of the five groups presented. In Figure 9A, the decrease in the portion of those with an upper secondary education or less in employment in tradable low-technology industries, which were affected by market exposure to competitive imports in the

1990s, is especially striking. The probability of a worker with no more than an upper secondary education being employed in tradable low-technology industries declined over the period from 16 to 9 percent. A similar trend was found among workers with a college education.

Figure 9A

Employment distribution of workers with upper secondary education or lower, 1995 and 2011

in the 4 industry groups in the business sector, groups are arranged from left to right in order of ascending average group wage



Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

An interesting point indicated by this figure is that, in parallel with the overall decrease in employment in low-technology industries, there is an increase in the employment rate of less-educated workers in the lower wage tier of the non-tradable industries. That is, low-skilled workers, previously employed in the tradable low-technology industries, are now

employed in the lower tier of the non-tradable industries, where productivity and average wages are lower.[21]

Among workers with a college education, the opposite is found; the employment shifts were to finance and advanced technology industries, where wages are higher (Figure 9B). This demonstrates the polarization that developed in the labor market following exposure to competitive imports, a phenomenon also documented in other countries that underwent similar processes.[22]

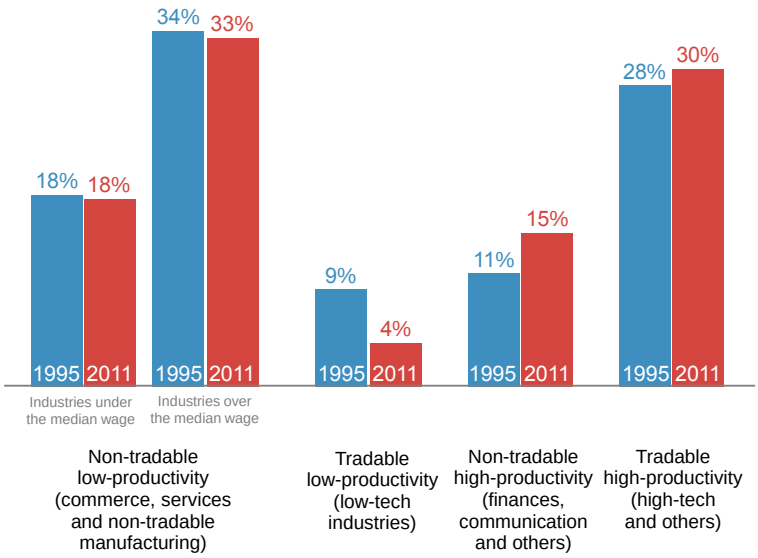
[21] Average hourly wage costs in tradable low-technology industries stood at NIS 39 per hour in 1995 while in the lower half of the non-tradable industries wage costs were on average NIS 20 per hour (in 2010 prices).

[22] Kimhi and Shraberman (2014) present evidence of polarization in the distribution of wages and work hours by occupations. The researchers show that in occupations characterized by low wages and in those characterized by high wages, the number of work hours increased relative to the number of work hours in medium-wage occupations.

Figure 9B

Employment distribution of workers with a college degree, 1995 and 2011

in the 4 industry groups in the business sector, groups are arranged from left to right in order of ascending average group wage



Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

Mobility Between Sectors in the Labor Market

As presented in the introduction, when workers' skills are not homogeneous and sectors in the labor market differ in the composition of their human capital, inter-sector mobility will be limited and wages in each sector will develop differently and independently.

A study by Endeweld (2012) shows that the level of mobility between wage deciles declined between 1990 and 2005. Since all four of the sectors examined in this chapter are characterized by a different wage

level, it can be assumed that the decline will also reflect a decrease in inter-sector mobility. This question is examined here. Ideally, mobility should be examined based on longitudinal panel data, but these data are not available in Israel, and there is no choice but to use the Central Bureau of Statistics *Labor Force Survey*, which is a short-term panel survey (subjects studied four times over one and a half years). Because the specific details of the labor force survey change over time, a pseudo-panel approach was taken by combining the details in categories characterized by certain observed properties, creating cells that are homogenous vis-à-vis those properties.

By this division, 50 groups were created, representing workers in five educational categories by years of education (less than 12, 12, 13-14, 15-16, and 17 or more) and 10 categories of potential experience[23] (multiples of 4 from 0 to 40).[24] Changes in the distribution of the groups among the sectors were used to evaluate the net mobility[25] of workers with different profiles between the four sectors in the labor market.

There are many ways to examine mobility in the labor market. The method used in this chapter examines the correlation between the distribution of workers over the various profiles in a given sector during a given period and the same distribution during a later period. The higher the correlation (on a scale of 0 to 1), the lower the mobility. The mobility index, as formulated using this method,[26] is affected by the transfer of

[23] Potential experience is computed according to the classification in Zussman and Friedman (2008): age minus years of schooling minus length of army service minus 6. For new immigrants the calculation is slightly different (see Appendix A in Zussman and Friedman).

[24] The relevant population was limited to ages 18-64, not including immigrants.

[25] That is, the number of transfers after a reduction by temporary moves.

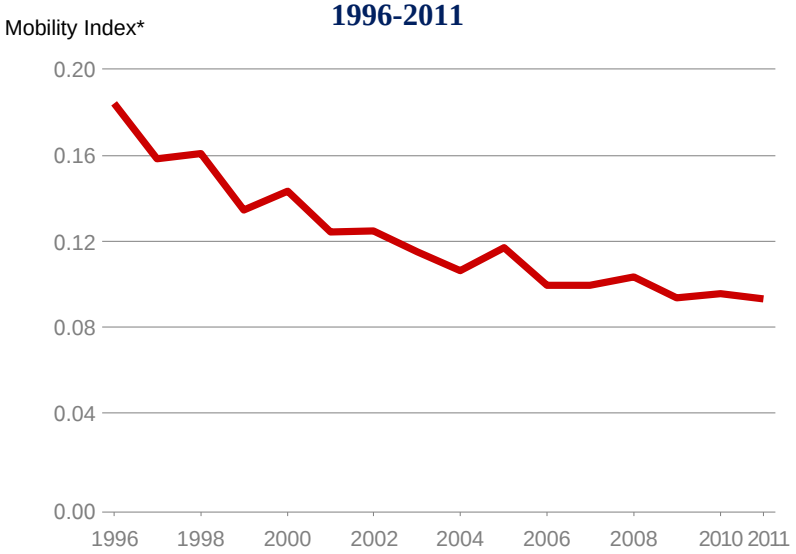
[26] Formally, the index is calculated as one minus the portion of the variance in the group's distribution in year *t* that is explained by the distribution in year *t-1*. A random cut-off of observations was performed so that the index was calculated over the same number of observations in each year.

workers between sectors as well as the changes in the distribution of new entrants to the labor market in the different industries.

Figure 10 presents the mobility indices from 1996 to 2011 and shows a decrease in the extent of mobility of work output between sectors in the labor market over the study period, along with a continuous slow-down in the rate of the decline.[27] This means that the changes in the distribution of human capital are happening less quickly than in the past, and there is a trend towards a certain level of stability by the end of the period.

Figure 10

Worker mobility between sectors in the labor market, 1996-2011



* Transfers of labor output and human capital between sectors in the labor market. Not including immigrants.

Source: Gilad Brand and Eitan Regev, Taub Center

Data: Central Bureau of Statistics, *Labor Force Surveys*

[27] Since the index is based on a synthesized panel, there may be an undervaluation of the cases of simultaneous movement between groups that were not counted because they canceled each other out; nevertheless, it is unlikely that the undervaluation explains the change over the long term.

On the whole, high mobility of workers between sectors serves to narrow wage gaps, but at the beginning of the study period the mobility between sectors was relatively high, and despite this there was actually an increase in wage gaps in Israel. It would seem that this is explained by a rapid change in the human capital distribution across the different sectors at the beginning of period as a result of an external factor (like trade liberalization measures), that led, among other things, to a forced transfer of low skilled workers to non-tradable sectors at lower pay and to a further erosion in relative wages (which were already low) and an increase in gaps. During the second half of the 2000s, a level of stability in wage gaps is seen (Figure 11B below). In these years, the mobility between sectors slowed down. This is a further indication that the increased mobility at the beginning of the period led to growth in the wage gap and not to a narrowing of it.

Appendix Section 2 presents the changes in the distribution of human capital in another way, without tradable low-technology industries. The comparison shows that the polarization process does not end with just a shrinking of low-technology industries and a growth in the relative portion of commerce and services, but also in further polarization of the mix of human capital within the commerce and services sector themselves. This comparison also shows that the process of polarization continued until the second half of the previous decade from which point there was a certain level of stability.

Effects of the Differences in Worker Traits on Productivity Gaps: An Empirical Examination

Assuming there is a direct relationship between average wages and average marginal worker productivity (labor productivity), and given that there is a positive correlation between workers' education and their wages, it may be expected to find higher productivity in industries with a higher percentage of college graduates. Therefore, is no surprise that the segmentation process which human capital has undergone since 1995 is accompanied also by polarization in labor productivity.

In this section, the degree to which the productivity gap between sectors decreases when taking into account the different human capital makeup is examined. For this purpose, a regression was run in which the dependent variable was the natural log of the average output per work hour in the industry, and the explanatory variable was a dummy representing the combined sector.[28] This regression was then rerun with ad additional explanatory variable for average worker education in the industry. In both cases the regression was run separately for each year in 40 industries.[29] As in the methodology presented by Mazar (2014), the gap between the dummy variables' coefficients represents the difference between the productivity gap dependent on worker education and the productivity gap that is independent of it, that is, the difference represents the part of the productivity gap rooted in the differences in worker education in each sector.

Figure 11A shows that the labor productivity gap between sectors has grown from about 30 percent at the beginning of the period to about 60 percent at the end of the first half of the 2000s and, when worker education is controlled for, the gap is about 10 percentage points less. Therefore, the differences in human capital explain part of the gap. It is interesting to note that the gap grew until 2004 and has since stabilized.

[28] Additional explanatory variables were initially included, but found to be insignificant.

[29] Formally, this estimation is calculated from the following formula:

$$\ln\left(gdp\_per\_hour_{i,t}\right) = \beta_0 + \gamma_t \cdot D + \varepsilon_{it}$$

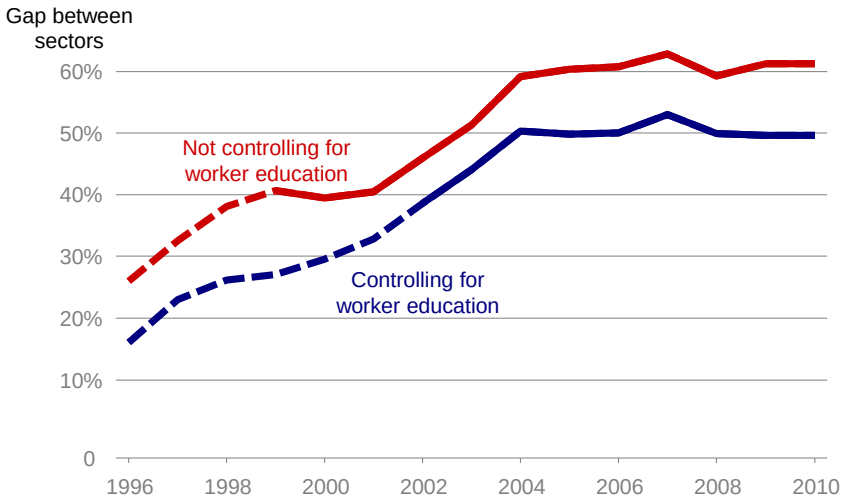
$$\ln\left(gdp\_per\_hour_{i,t}\right) = \beta_0 + \beta_1 x_{it} + \delta_t \cdot D + \varepsilon_{it}$$

x_{it} represents the average number of years of schooling in industry *i* in year *t*; D is a dummy variable with a value of 1 for the combined sector and 0 for the non-tradable low-productivity sector; γ_t and δ_t represent coefficients of the dummy variable; γ_t - δ_t represent the difference between the unconditional productivity gap and the gap that accounts for differences in education.

Figure 11A

Productivity gaps between the non-tradable low-productivity sector and the remaining business sectors

before and after controlling for worker education, 1995-2010*



* Two-year moving average. The broken line represents years when the gap between the sectors was not statistically significant.

Source: Gilad Brand and Eitan Regev, Taub Center

Data: Central Bureau of Statistics

It should be noted that the test referred to differences in education only, and not differences in other, unobserved characteristics among workers – such as motivation, intelligence, and perseverance – and an additional part of the gap may be explained by differences in these traits.

Now that the effect of differences in workers' human capital on productivity gaps has been demonstrated, the trend in this effect over the years 1997 to 2011 will be examined. To this end, micro-data were collected on wages (from the Central Bureau of Statistics, *Income Survey*) and an additional test was conducted using the same methodology. Note, however, that this estimation procedure relies on the assumption that

wages reflect productivity. Due to the use of micro-data, additional explanatory variables, such as gender and experience, were added.[30]

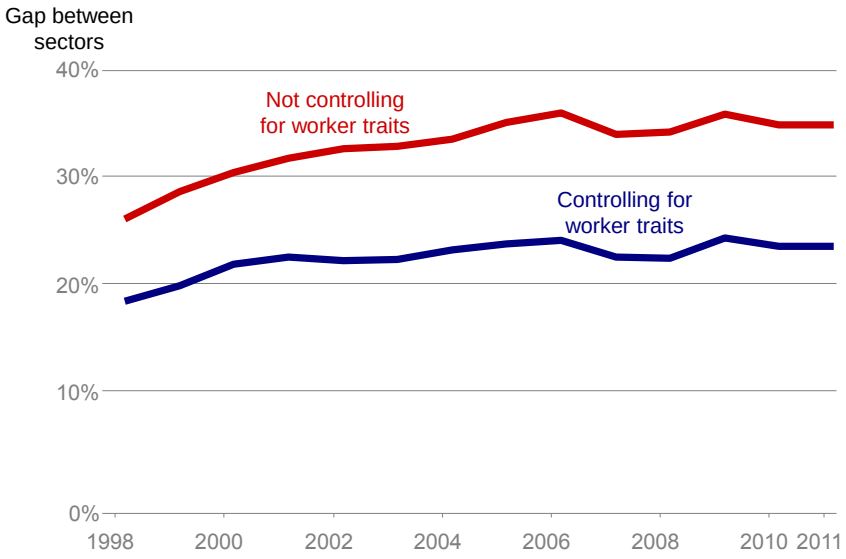
Figure 11B presents the difference between the raw wage gap and the gap that accounts for workers' traits. Figure 12 presents the difference between them. As can be seen, the difference between the gaps increases over most of the time period, becoming somewhat stable during the second half of the last decade. This means that the workers' different traits had a growing role in the process of divergence in productivity and wage trends in different sectors.

[30] This estimation was conducted using the standard Mincer equation with a dummy variable for the combined sector. The estimation is based on micro-data for working age individuals (ages 25-64) who work at least 10 hours a week. The previous regression analyses were based on averaged industry data, and as a result only average years of schooling for workers in the industry was found to be a significant explanatory variable.

Figure 11B

Wage gaps between the non-tradable low-productivity sector and the remaining business sectors

before and after controlling for worker education, 1995-2010*



* Two-year moving average

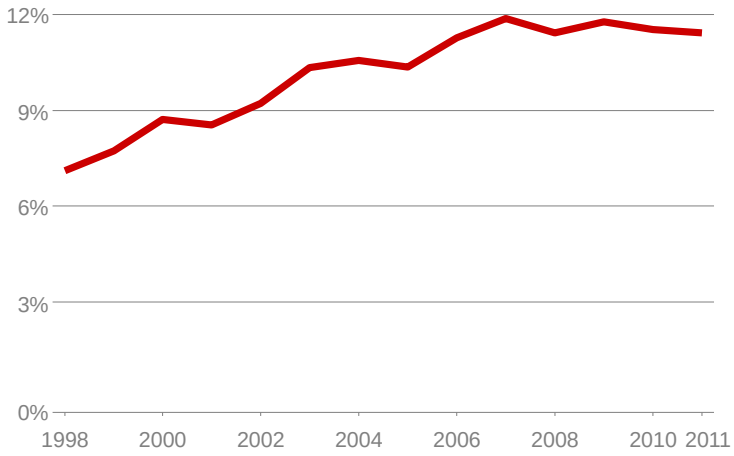
Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

The increased difference between the raw wage gap and the gap adjusted by worker traits can be attributed to two possible factors. The first is that the human capital of workers in the combined sector expanded more than in the non-tradable low-productivity industries. The second is that returns on human capital in the non-tradable low-productivity sector eroded compared with returns in the other industries (and, of course, a combination of both factors is possible).

Figure 12

Wage gaps between the non-tradable low-productivity sector and the remaining business sectors: the difference between the raw wage gap and the gap adjusted for worker traits

the difference between the correlation coefficients for wages, 1997-2011*



* Two-year moving average

Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

As it was found that accumulated human capital in the combined sector (tradable industries and high-productivity non-tradable industries) did indeed increase more rapidly (Figure 8 above), it remains to be seen whether a change also occurred in returns on human capital in each of the sectors under study. For this purpose, returns on a year of education were examined in the combined sector in comparison with the non-tradable low-productivity sector (Figure 13).[31] College wage premiums are higher

[31] The wage equation is calculated using the standard Mincer equation. The estimation is based on individual data (the most noteworthy explanatory variables are years of schooling, potential experience and gender) for working

in the combined sector, and over time the trends in the two industries are different; in the combined sector, returns per year of education have increased over the years, while returns remained almost unchanged in the non-tradable low-productivity sector. In other words, college wage premiums in the non-tradable low-productivity industries eroded over time compared to the combined sector.[32]

In summary, the differences in the productivity trajectory also result from the widening disparities in the makeup of human capital in each sector. The changes in this area are rooted, among other things, in the movement of low skill workers from low-technology industries to the lower-wage tier of the non-tradable industries. An empirical assessment has shown that one part of the productivity gaps can be explained by differences in workers' human capital, and this part has grown over the years. This has occurred because, compared to high-productivity industries and the tradable sector, the human capital of workers in the non-tradable low-productivity sector has improved to a lesser degree, and returns on education have eroded.

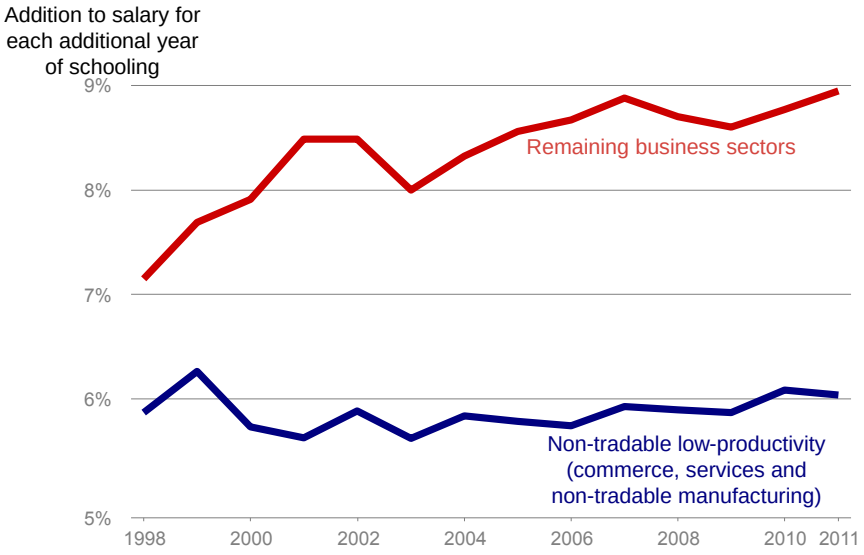
age individuals (ages 25-64) who work at least 10 hours a week. The equation is calculated for each year separately. The estimate of college wage premium does not take into consideration unexpected traits and so it is likely to be an overestimation. Nevertheless, Frish (2007) and Kriaf (2008) find that the causal relationship between education and wages that is found using an instrumental variable is not different from that found using OLS.

[32] Brand (2014) shows that, in tradable industries, there is a co-integrative relationship (that indicates a causal relationship) between education and labor productivity, while in the non-tradable industries a correlation was not found between the variables. Evidence in this direction is also found in a study conducted by the Bank of Israel (2014). This is an indication of low college wage premiums in the non-tradable industries, when examined in GDP terms.

Figure 13

College wage premium, 1997-2011*

in non-tradable low-productivity sector relative to the remaining business sectors, in percent



* Two-year moving average

Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

5. *Differences Between Price Increases in Various Sectors and Their Effects on the Productivity Gap*

To this point, the developments of productivity and wages in the various industries were presented in real terms. This section will examine how productivity gaps developed in nominal terms. The basis for this comparison is rooted in the economic theory presented above which

holds that increased productivity in one sector will bring about a transfer of workers to that sector and an increase in wages in all other industries as well (subject to certain assumptions). According to this scenario, because productivity in the other industries improves less, the result of long-term equilibrium would be increased prices, compensating for increased wages; the increased prices should lead to an increase in the value of marginal output for workers in these industries and, as a result, also increase productivity in nominal terms. [33]

In addition, as noted in the introduction, labor productivity in the non-tradable industries is less affected by innovation and technological improvements compared with tradable industries, so that their growth potential in real terms is more limited. Therefore, it may be that the main influence on wages lies in indirect influence through real growth in tradable industries. With this in mind, it is interesting to examine whether the productivity gaps increased in nominal terms as well, irrespective of the different price trajectories in the various sectors.

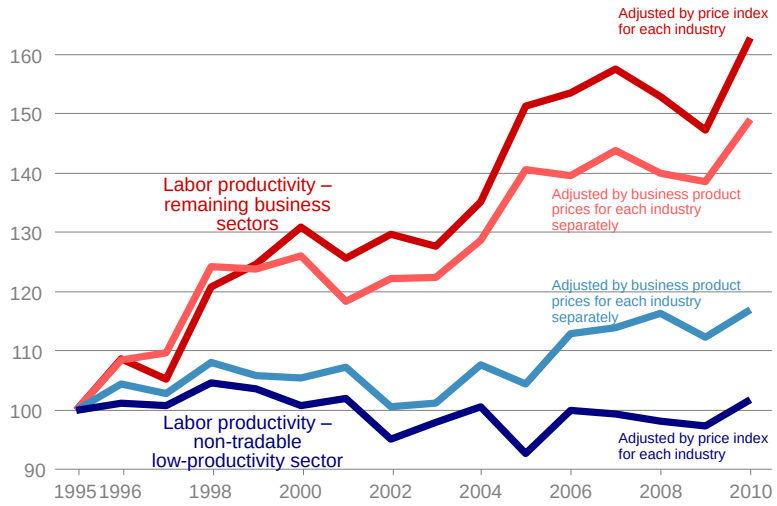
Figure 14 presents the growth of labor productivity using the business sector GDP deflator for all industries, and for each industry separately using a separate deflator for each industry (deflating all industries by the same deflator yields a result that is equivalent to the nominal comparison). The figure includes non-tradable low-productivity industries relative to the rest of the business sector. As expected based on economic theory, prices rose unevenly. Nominal productivity gaps still widened but to a lesser degree than real productivity gaps.

[33] Baumol-Bowen (1966) describes the existence of this mechanism through an example from the field of the performing arts. This field is almost completely uninfluenced by technological developments, and so there is no expectation of a rise in their productivity. Nevertheless, the marginal output value of these workers rose over the years similar to the rise in wages in the overall labor market. The researchers explained this paradox by saying that an erosion of wages relative to the rest of the labor market causes a shortage of workers in the field and so a consequence of equilibrium causes a direct relationship between wages of workers in this field and the rest of the labor market.

Figure 14

Labor productivity development, 1995-2010

non-tradable low-productivity sector relative to the remaining business sectors, Index: 1995=100



Source: Gilad Brand and Eitan Regev, Taub Center
Data: Central Bureau of Statistics

6. *Summary*

Over the past two decades, two very different sectors have formed in the Israeli labor market. The first includes high-tech, finances and advanced industries, characterized by high-productivity and high wages, which increase rapidly as well. The other sector is the commerce and non-tradable service industries in which productivity is low, wages are low and growth is marginal.

The polarization in the labor market has developed against a backdrop of decreased employment rates and more rapid processes of reorganization and streamlining in those low-technology industries

exposed to imports. The study indicates that low-skilled workers previously employed in low-technology industries are now increasingly employed in occupations in the lower-wage tier of the service and commerce industries. In contrast, among skilled workers an opposite picture has emerged: increased movement to high-productivity industries, accompanied by higher wages. The regression analyses indicate that the deepening differences between workers' traits in the various sectors explain a growing part of the productivity gaps.

The study presents evidence of a decrease in worker mobility between different segments of the labor market and also shows that working in a high-productivity industry requires higher education than before – meaning that the probability that an individual with less education will move into an industry with high-productivity has decreased over time.

Examining the correlation between the different sectors' wage trajectories indicates a weakening over time, in particular between low-productivity and high-productivity industries. This situation, in which the wage trajectories of groups of industries grow apart, is made possible due to increasing differences in worker profiles and due to decreased mobility between different sectors. The evidence indicates that the divergence processes continued until the end of the first half of the 2000s, after which time a degree of stabilization was noted.

The findings presented in this chapter show that the industries left behind are non-tradable labor intensive services. Instead of using the increase in accumulated human capital in the economy and the technological advances that have taken place during this period, these industries have continued to rely on low-wage labor, among other things, due to decreased employment rates in the low-technology industries.

One possible course of action is to create vocational training programs to increase occupational mobility between sectors. In addition, policy makers should consider encouraging investment in innovation and research and development in low-technology industries – thereby encouraging diversification in the composition of exports. Policy measures in this direction will make it possible to create wage pressures in low-productivity industries and decrease gaps in the labor market.

Appendix

1. Wage Development in Different Sectors

In the third section of the chapter, evidence was presented of a weakening in the relationship between wages in different sectors and particularly between wages in the low-productivity industries and those in the high-productivity industries. In this section, this finding will be examined in more detail.

At the center of this study is the relationship between salaries in the non-tradable low-productivity industries and those in high-productivity industries. In order to compare between industries in which the salaries and worker traits are relatively the same, an additional comparison was performed between sectors without those industries where the salaries are low. The exclusion was done on the basis of the median wage in 2010: industries in which the average wage was lower than the median were excluded from this comparison.[34]

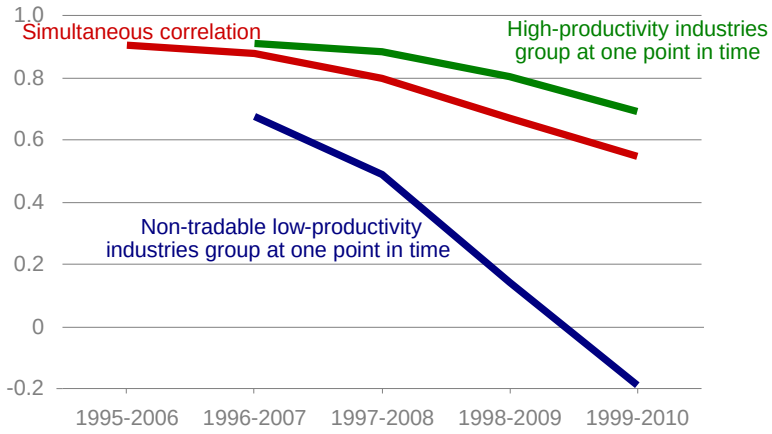
Appendix Figure 1 presents the correlation coefficient between salaries in low-productivity industries included in the comparison and high-productivity industries (high-tech, finance and advanced technologies without tradable low-technology industries). As in the second section, here, too, the coefficients are presented in moving periods in three forms: a one-period lead or lag for each of the sectors and a simultaneous cross-correlation.

[34] Industries included in the comparison are: warehousing, parking lots and cargo terminals; post and courier services; motorized vehicles, motorcycles and bicycles, and trade of fuel; wholesale trade; other business activities; entertainment, culture and sports activities; paper and paper products; food products.

Appendix Figure 1

Pearson Product-Moment Correlation coefficient* of salaries, 1995-2010

in industries with high productivity** and
non-tradable low-productivity industries***



* The comparison is presented for the correlation in the same period in the two groups (red line), as well as for productivity at given points in time for each group where one group leads (green and blue lines).

** Including high-tech, finance and advanced technologies

*** The comparison includes half of the industries included in the non-tradable low productivity group. Industries below the median wage level were not included in the comparison.

Source: Gilad Brand and Eitan Regev, Taub Center

Data: Central Bureau of Statistics

The comparison shows the weakening of the relationship between the industries, and gives an indication that the high-productivity industries are more dominant in setting wages – that is, the non-tradable low-productivity industries may react to wage developments in the high-productivity industries and not vice versa.

To strengthen this indication, Granger-Causality tests were performed to examine the causal direction for all of the industries in the sample. These show that for workers with 15 years of schooling or more, wages are led by those in combined sectors in the non-tradable low-productivity sector and not vice versa No evidence was found using the Granger Causality test of a causal relationship among workers with low education levels. Further research in this direction is required.

2. *Changes in the Human Capital Mix in the Different Sectors*

In order to shed light on the segmentation in the distribution of human capital in the various labor market sectors over the study period, this chapter used the Pearson $\chi 2$ test that calculates the probability of differences in the distribution between two samples occurring randomly (under the null hypothesis that the two distributions are identical).[35] Using this test, the distribution of workers in five educational categories (represented by years of schooling – less than 12; 12; 13-14; 15-16; 17 or more) were examined to see if there is a difference between non-tradable low-productivity industries and high-productivity industries.[36]

As expected, the result was positive. Of more interest, though, is the development over the study period. The sharp increase in the statistical value, presented in Appendix Figure 2, up until the second half of the previous decade means that the polarization became stronger over the period, along with a certain stabilization in the past few years.

[35] A random cut-off of observations was made so that the calculations for the number of observations were equal for each year.

[36] In this calculation, low-tech manufacturing industries were not included due to the rapid decline in the amount of employment in these industries.

Appendix Figure 2

Pearson χ^{2*} for the differences in the distribution of human capital**

non-tradable low-productivity sector relative to the remaining business sectors (without tradable low-tech industries), 1995-2011***

* For convenience, the coefficient is divided by 10.

** Excluding immigrants

*** Two-year moving average. A random cut-off of observations was performed so that the calculation has the same number of observations in each year.

Source: Gilad Brand and Eitan Regev, Taub Center

Data: Central Bureau of Statistics

3. *Division of the Business Sector*

Appendix Table 1. **Division of the business sector into groups according to tradability and productivity level**

(continued on next page)

Industry name*	**Code**
Tradable high-productivity industries	
Chemicals, chemical products, refined petroleum	23-24
Non-metallic mineral products	26
Machinery and equipment	29-30
Electric motors and electric distribution apparatus	31
Electronic components	32
Electronic communication equipment	33
Industrial equipment for control and supervision, medical and scientific	34
Transport equipment	35
Water and air transport	61-62
Auxiliary transport activities	63
Computer and related services, research and development	73-74
Non-tradable high-productivity industries	
Beverages (alcoholic and non-alcoholic) and tobacco products	16
Telecommunication	66
Banking and other financial institutions	67
Insurance and social insurance funds	68
Tradable low-productivity industries	
Textiles	17
Apparel (excluding knitted)	18
Footwear, leather and its products	19

Appendix Table 1. **Division of the business sector into groups according to tradability and productivity level**

(continued from previous page)

Industry name*	**Code**
Tradable low-productivity industries	
Wood and wood products (excluding furniture)	20
Plastic and rubber products	25
Basic metal	27
Metal products (excluding machinery and equipment)	28
Furniture	36
Not elsewhere specified	39
Non-tradable low-productivity industries	
Food products	14-15
Paper and paper products	21
Publishing and printing	22
Motor vehicles, motorcycles and bicycles, and trade of fuel	50
Wholesale trade (excluding motor vehicles and motorcycles)	51
Retail sale and repairs (excluding motor vehicles)	52-53
Hotels and guest houses	55
Restaurants and dining services	56
Land transport	60
Storage and parking lots	64
Post and courier activities	65
Labor recruitment and provision of personnel	74
Security and cleaning activities	75
Business activities not elsewhere classified	76
Recreational, cultural and sport services	94
Hairdressing and beauty salons	95

* According to the Central Bureau of Statistics Standard Industrial Classification 1993

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